EA-87-02

Ontario

ENVIRONMENTAL ASSESSMENT BOARD

VOLUME: 240

DATE: Monday, October 1, 1990

BEFORE:

A. KOVEN Chairman

E. MARTEL Member

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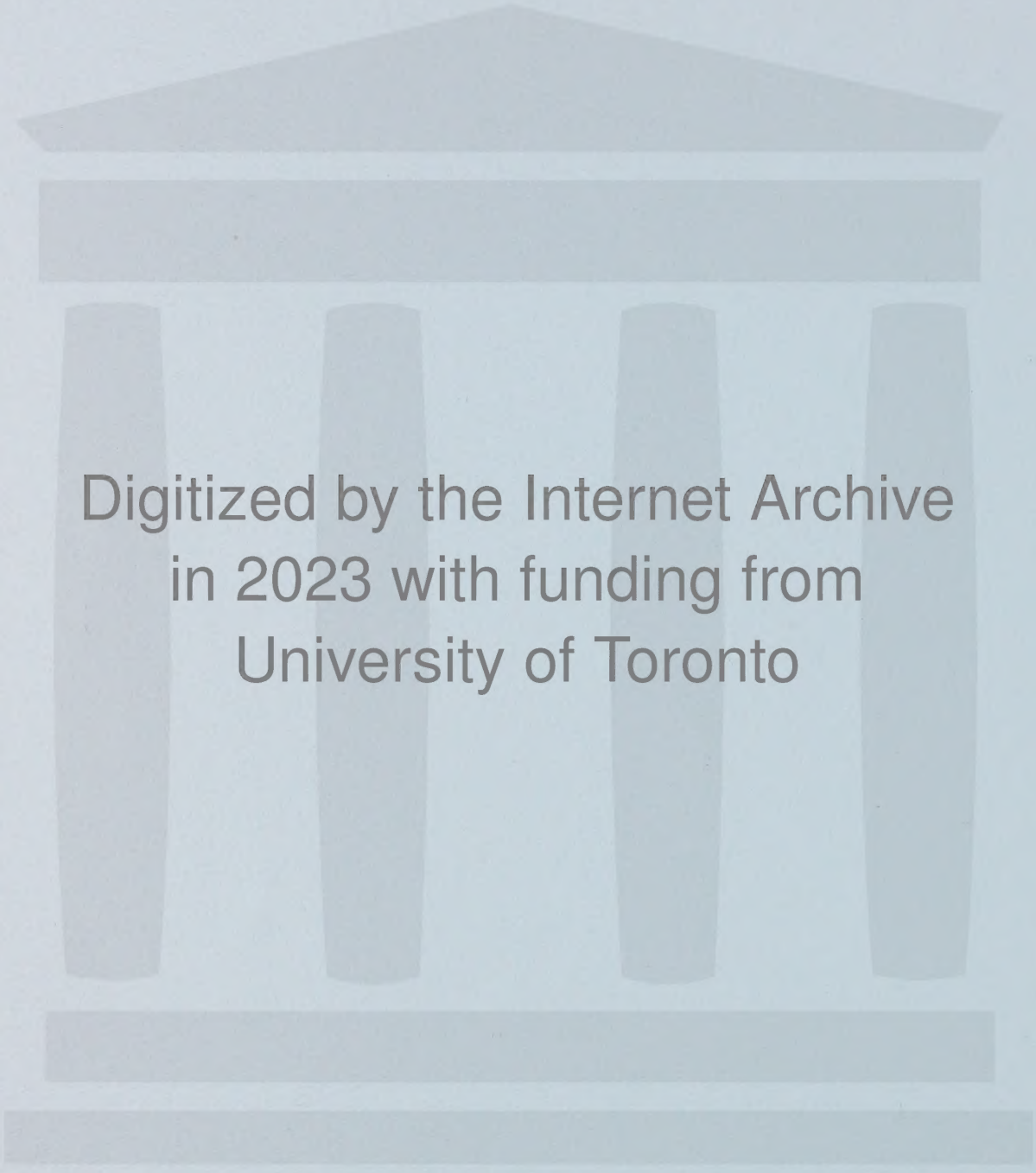

EA-87-02

HEARING ON THE PROPOSAL BY THE MINISTRY OF NATURAL RESOURCES FOR A CLASS ENVIRONMENTAL ASSESSMENT FOR TIMBER MANAGEMENT ON CROWN LANDS IN ONTARIO

IN THE MATTER of the Environmental Assessment Act, R.S.O. 1980, c.140;

- and -

IN THE MATTER of the Class Environmental Assessment for Timber Management on Crown Lands in Ontario;

- and -

IN THE MATTER OF a Notice by the Honourable Jim Bradley, Minister of the Environment, requiring the Environmental Assessment Board to hold a hearing with respect to a Class Environmental Assessment (No. NR-AA-30) of an undertaking by the Ministry of Natural Resources for the activity of timber management on Crown Lands in Ontario.

Hearing held at the offices of the Ontario Highway Transport Commission, Britannica Building, 151 Bloor Street West, 10th Floor, Toronto, Ontario, on Monday, October 1, 1990, commencing at 10:00 a.m.

VOLUME 240

BEFORE:

MRS. ANNE KOVEN	Chairman
MR. ELIE MARTEL	Member

A P P E A R A N C E S

MR. V. FREIDIN, Q.C.) MS. C. BLASTORAH) MS. K. MURPHY)	MINISTRY OF NATURAL RESOURCES
MR. B. CAMPBELL) MS. J. SEABORN) MS. B. HARVIE)	MINISTRY OF ENVIRONMENT
MR. R. TUER, Q.C.) MR. R. COSMAN) MS. E. CRONK) MR. P.R. CASSIDY)	ONTARIO FOREST INDUSTRIES ASSOCIATION and ONTARIO LUMBER MANUFACTURERS' ASSOCIATION
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MR. D. HUNTER) MS. N. KLEER)	NISHNAWBE-ASKI NATION and WINDIGO TRIBAL COUNCIL
MR. J.F. CASTRILLI) MS. M. SWENARCHUK) MR. R. LINDGREN)	FORESTS FOR TOMORROW
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MR. R. EDWARDS) MR. B. McKERCHER)	NORTHERN ONTARIO TOURIST OUTFITTERS ASSOCIATION

APPEARANCES: (Cont'd)

MR. L. GREENSPOON) MS. B. LLOYD)	NORTHWATCH
MR. J.W. ERICKSON, Q.C.) MR. B. BABCOCK)	RED LAKE-EAR FALLS JOINT MUNICIPAL COMMITTEE
MR. D. SCOTT) MR. J.S. TAYLOR)	NORTHWESTERN ONTARIO ASSOCIATED CHAMBERS OF COMMERCE
MR. J.W. HARBELL) MR. S.M. MAKUCH)	GREAT LAKES FOREST
MR. J. EBBS	ONTARIO PROFESSIONAL FORESTERS ASSOCIATION
MR. D. KING	VENTURE TOURISM ASSOCIATION OF ONTARIO
MR. D. COLBORNE) MS. S.V. BAIR-MUIRHEAD)	GRAND COUNCIL TREATY #3
MR. R. REILLY	ONTARIO METIS & ABORIGINAL ASSOCIATION
MR. H. GRAHAM	CANADIAN INSTITUTE OF FORESTRY (CENTRAL ONTARIO SECTION)
MR. G.J. KINLIN	DEPARTMENT OF JUSTICE
MR. S.J. STEPINAC	MINISTRY OF NORTHERN DEVELOPMENT & MINES
MR. M. COATES	ONTARIO FORESTRY ASSOCIATION
MR. P. ODORIZZI	BEARDMORE-LAKE NIPIGON WATCHDOG SOCIETY

APPEARANCES: (Cont'd)

MR. R.L. AXFORD	CANADIAN ASSOCIATION OF SINGLE INDUSTRY TOWNS
MR. M.O. EDWARDS	FORT FRANCES CHAMBER OF COMMERCE
MR. P.D. McCUTCHEON	GEORGE NIXON
MR. C. BRUNETTA	NORTHWESTERN ONTARIO TOURISM ASSOCIATION

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I N D E X O F E X H I B I T S

---Upon commencing at 2:05 p.m.

MADAM CHAIR: Good afternoon. Please be seated.

Good afternoon, Ms. Swenarchuk.

MS. SWENARCHUK: Good afternoon, Madam Chair, Mr. Martel.

We will begin this afternoon with a brief statement outlining our case and then we will be prepared to commence with our first witness.

MADAM CHAIR: Are these microphones on?

Please go ahead.

MS. SWENARCHUK: Forests for Tomorrow is pleased to have the opportunity to open its case before you as the first intervening party in opposition to present evidence in this hearing.

You will recall that Forests for Tomorrow is a coalition of five environmental groups with membership from every corner of the province, which came together for the purpose of intervening in this hearing. The groups are: The Federation of Ontario Naturalist, the Wildlands League, the Temiskaming Environmental Action Committee, the Botany Conservation Group of the University of Toronto and the Sierra Club of Ontario. Present and observing today are members and officials of these groups.

The coalition was formed and has functioned for the purpose of attempting to participate and reply to the issue of the case in the most comprehensive manner that resources would permit. Therefore, evidence has been prepared on a full range of issues long of interest to conservation groups including concepts of non-timber values, old growth forest, wildlife and biodiversity and integrated forest planning, but, in addition, Forests for Tomorrow is ready to engage in the debate regarding the on-ground practises of the forest industry, the economics and mechanics of forestry operations, logging and regeneration and the question of long-term wood supply.

However, to our knowledge, no intervenors in Canada have been faced with the scale of the task that has met my clients; that of replying to evidence developed and presented over two and one half years by party as well funded as the largest Ministry of the largest province in Canada and the Ontario section of Canada's leading industry. My clients' relatively limited resources, by comparison, have of necessity limited the number and scale of issues to which they are able to respond.

Ten witness statements have been distributed and barring unforeseen changes in

circumstances, we expect these subjects to constitute the entire case for Forests for Tomorrow. The considerable task has been undertaken and I wish to indicate for you the underlying principles which have guided the development of the case.

First, Forests for Tomorrow sees the forests of Ontario as a complex of ecosystems which must be managed in accordance with the ecological principles underlying their existence and functioning. Therefore, ecological concepts and rationale will be referred to frequently in the evidence you will hear in virtually all witness statements and testimony.

Second, Forests for Tomorrow is cognizant of the need for community stability in resource-based industries, communities and, therefore, has attempted to grapple directly with the economic issues related to forestry. Consideration of economic factors is a second fundamental principle of the evidence prepared for you.

Third, Forests For Tomorrow has considered from the beginning of the case that it is most important that the Board have the opportunity to hear not merely evidence of potential impacts of forestry on the forest ecosystem, but also evidence of actual impacts. And to the extent the coalition

resources permit, that evidence has been prepared.

Turning now to an outline of the evidence to be presented.

To lay the foundation of ecological processes and concerns, our first witness, Dr. Tom Hutchinson, will testify to the ecological processes of our forests and then to some of the issues of concern regarding industry practices and other influences on forest growth.

He will testify that the scientific literature of Europe, the United States and Canada regarding nutrient depletion as a result of fiber removal leads to serious concerns that full-tree harvesting on moderate to poor nutritional sites will inevitably cause restrictions to the ability of such sites to successfully grow second and subsequent generations of forest, in the absence of mediating applications.

He will further testify that conventional clearcutting causes site acidification on some sites and affects water quantity and the chemistry of water leaving the sites.

He will testify that the effects of conventional large area clearcutting are not at all identical to the effects of fire - a natural recurring

and controlling factor in many forested eco-systems. Rather, that most fires are of small size and have positive effects on nutrient availability, levels of acidity and reduction of hardwood competition that are not emulated by logging.

He will also testify to possible consequences for forest growth and future yield of climate change and atmospheric deposition.

Following Dr. Hutchinson's evidence, the Board will hear from eight individuals, six from Ontario, one from Winnipeg -- from northern Ontario, one from Winnipeg and one from Toronto regarding actual impacts of forest management actions on particular areas of Ontario. In addition, they will provide information regarding public consultation in timber management planning, the level of protection accorded to non-timber values and the likely adequacy of bump-up provisions as proposed by the Ministry of Natural Resources.

Forests For Tomorrow's third witness statement is concerned with ecological issues related to regeneration and ultimately to logging practices. In short, what are the disadvantages of the large area clearcutting management now practised in our forests.

The witness, George Marek, is a

registered professional forester who has lived and practised forestry in one locale in northern Ontario for 40 years and he will testify that small area clearcutting for boreal conifer species to enhance natural regeneration is ecological preferable to the current reliance on large area clearcutting and artificial regeneration.

Forests For Tomorrow's support for this position was evident in its draft terms and conditions filed in January of this year and will be further evidenced in its revised terms and conditions.

Following Marek's evidence, Dr. Robert Payne of Lakehead University will testify regarding the range of non-timber values associate with our forests and the development of an environmental ethic, giving priority to activites which tend to preserve the integrity, stability and beauty of the biotic community. He will testify to the need to manage non-timber values in our forests with a more comprehensive forest planning system.

Further, the Board will hear that the MNR essentially remains a conservative bureacracy that has not kept pace with the dramatic changes that are occurring in its operating environment.

The evidence of Crandall Benson, also of

Lakehead University, will follow that of Dr. Payne and will assist the Board in two separate areas. First, he will testify to the technical issues of allowable cut calculation and projections of future wood supply. He will conclude that present levels of depletion of wood exceed accruals, so that a drop in timber supply is occurring.

He will add his professional opinion as a forester to that of George Marek, that logging for planned natural regeneration of the forest is a preferable approach to that of large area clearcut management and artificial regeneration and he will add the economic rationale to the argument that investing in intensive management is a social cost to the people of Ontario.

The second subject area for his evidence results from his examination of nineteen timber management plans and on-ground inspections of most of the units for which the plans were written. He will testify that there are significant negative on-ground impacts from logging. These include declining wood supply resulting from allowable cuts that are too high and regenerations that are insufficient to regenerate the logged areas, even if the regeneration efforts were a hundred per cent successful.

Further, his evidence will indicate that cut-overs are not laid out with consideration for aesthetics, that cutting close to or up to waterbodies occurs frequently, and that prescriptions for protection of non-timber values give no indication of a long-term ability to provide habitat and/or to protect the site.

Finally, he will testify that clearcuts are much too large for site protection or to ensure that species diversity of all life forms will be maintained. Using satellite photography and on-ground inspections, he will provide measurements for contiguous clearcuts in various management units in the thousands of hectares. Examples will include units with contiguous cuts of 8500, 20,000, 50,000 and as much as 269,000 hectares. For those of who cannot envision a hectare, one hectare equals 2.2 football fields.

From this evidence of current on-ground practices in Ontario, we will turn to a consideration of ecologically sustainable forestry including old growth forests. Mr. Chris Maser of the United States Environmental Protection Agency will testify that the utilitarian view that forests are endless producers of products and commodities is at odds with the ecological

processes within the forest and must be replaced with a new approach that views the forest as a living organism with ecological limits on the products that can be harvested. He will testify to the reasons for protecting old growth forests and that intensive plantation management can lead to the exhaustion of the soil and collapse of the forest ecosystem.

The seventh subject area of FFT's evidence concerns the economics of forest management in Ontario, as well as deficiencies and economic analysis evident in the Ministry's EA document and planning process.

Drs. Andrew Muller and Peter Morrison will testify that mainstream economists recommend that forests and other assets be managed to yield the greatest possible net benefit to society and that the planning process proposed by the Ministry is unlikely to achieve this purpose.

Further, they will contend that the procedure of cost/benefit analysis, if utilized at the management unit level, will contribute to meeting the requirements of the Environmental Assessment Act for consideration of alternatives in the development of timber management plans. They will testify that consideration of alternatives at the management unit

level should entail evaluation of different land uses and not merely assume timber extraction with the constraints of the area of concern process.

The economists have prepared an illustrative cost/benefit analysis of alternative approaches to timber management for a hypothetical management unit. The alternatives examined are: (1), management for non-timber values only; (2), modified harvesting to enhance natural regeneration; (3), conventional large area clearcutting with reliance on artificial regeneration; and (4), conventional large area clearcutting with no artificial regeneration.

They conclude that current values of wood are such that no harvest at all may well be the preferred option for some management units and that only the allowable cut effect and an unrealistically low interest rate can justify artificial regeneration expenditures. Modified harvesting combined with natural regeneration may be the economically preferred management option in some circumstances.

So you see then that we are considering modified -- the option of modified harvest with natural regeneration, both from the ecological perspective and the economic perspective.

Forests For Tomorrow's eighth area of

evidence addresses concerns regarding wildlife, defined by the coalition as all non-domesticated, biological organisms and it concerns management for biodiversity, encompasssing all species of plants, animals and organism. This range encompasses the tallest white pine to the smallest soil dwelling micro organism and the ecosystems of which they form a part.

Drs. John Middleton, James Bendell and Roger Suffling will testify to the inadequacies of the current system of wildlife management based on featured species in Ontario and to the need to move to an ecosystem-based management system. This would entail preserving and managing all ecosystem elements analogous to forest stand types in proportion to their occurrence and spacial configuration in the natural landscape.

The Board will hear testimony that every natural stand type, regardless of its commercial value, has value to wildlife and should be sufficiently represented in the forests to ensure that it is sustainable. Further, that in order to manage for biodiversity, all stand types and stand ages need to be represented in the managed natural forest with a heterogeneous mixture of many small and some large clearcuts typical of a natural fire dominated

landscape.

An important strategy for achieving this purpose will be routine monitoring of species as a measure of ecosystem health, as well as the application of landscape ecology, land management.

The Board will hear that the evolving direction of a current MNR/ESSA "Other Wildlife" workshop process is supportive of landscape-based management approach.

The ninth subject of the Coalition's evidence will be the public health issues related to the use of the herbicide 2,4-D in forest management. Dr. Marvin S. Legator will testify that 2,4-D is a toxic chemical that affects almost every organ in the body. The effects include acute and chronic toxicity. It is a developmental toxin causing multiple birth defects in several biological systems, skeleton, blood system and nervous system.

The class of herbicides of which 2,4-D is a member has been shown to increase several types of cancer in humans. Although there are several ongoing studies, and data gaps exist, the limited studies indicate that this a highly hazardous substance. Notwithstanding all the limitations of epidemiology studies, multiple human studies are consistent with

this chemical being a probable multi-organ carcinogen. Dr. Legator will conclude that this herbicide should not be used in the Crown forests of Ontario.

Finally, as the Board is aware from the draft terms and conditions prepared by Forests for Tomorrow in January of this year, the coalition proposes that the planning process for forest management be substantially changed after a five-year preparation period to accord with the process outlined in condition 62 of those terms and conditions.

The proposed planning process, inspired by the process now utilized on the United States national forests, is based on the requirement to study and develop a spectrum of alternate land use plans for each forest unit to assess the environmental impacts of each, and finally then to choose which plan to implement. Thus, timber extraction becomes only one of the possible uses of forested land.

Mr. Zane Smith, a Professional Forester and recently retired United States Forest Service senior manager, will testify to the history of the development of the American planning process and its advantages in achieving integrated resource planning. He will testify that it is possible to write forest management plans giving consideration to ecological

values and biodiversity and that current American plans reflect the public values more nearly than did past plans.

Mr. Smith will also analyse the Ontario system proposed by the Ministry and suggest changes and improvements. His testimony will include evidence of how a large and established bureaucracy can evolve to reflect changed public values and demands.

We expect his testimony then to conclude the case Forests for Tomorrow.

I believe I would like to commence then by filing and numbering a certain number of exhibits to be used during the testimony of Dr. Hutchinson, wanting to number Dr. Hutchinson's witness statement No. 1 and No. 1A, his curriculum vitae and a letter of errata to the witness statements which Mr. Huff is distributing at this moment.

MADAM CHAIR: Do you want separate exhibit numbers for these, Ms. Swenarchuk?

MS. SWENARCHUK: Perhaps they can be A and B.

MADAM CHAIR: All right. Exhibit 1405A will be witness statement No. 1 and witness statement No. 1A will be 1405B.

Do you want the errata to be separate?

MS. SWENARCHUK: It could be separate I guess, if it would be appropriate.

MADAM CHAIR: All right. That will be Exhibit 1406.

We are trying to keep our exhibit list in good order, so we might give the number of pages for the witness statements. Witness statement No. 1 comprises 34 pages.

MS. SWENARCHUK: Right.

MADAM CHAIR: Witness statement No. 1A is 27 pages and the errata is one sheet?

MS. SWENARCHUK: That's right. And then there is also the curriculum vitae which is, I suggest, Exhibit 1406 -- 1407.

MADAM CHAIR: And this is Dr. Hutchinson's CV.

MS. SWENARCHUK: That's right.

MADAM CHAIR: And that has 35 pages.

---EXHIBIT NO. 1405A: Witness statement No. 1 of Dr. Tom Hutchinson consisting of 34 pages.

---EXHIBIT NO. 1405B: Witness statement No. 1A of Dr. Tom Hutchinson consisting of 27 pages.

---EXHIBIT NO. 1406: Letter of errata to the witness statements of Dr. Tom Hutchinson consisting of one page.

---EXHIBIT NO. 1407: Curriculum vitae of Dr. Tom Hutchinson consisting of 35 pages.

MS. SWENARCHUK: If I just might know what time you would intend to take a break this afternoon.

MADAM CHAIR: We are going to sit until five today, which is a short day, and I'm sorry the first day of your case is so abbreviate.

Why don't you select a place you want to break. There will be one break.

MS. SWENARCHUK: Fine. I would ask you to swear the witness, Madam Chair.

MADAM CHAIR: Yes. Dr. Hutchinson, could you come forward, please.

TOM HUTCHINSON, Sworn

MS. SWENARCHUK: Good afternoon, Dr. Hutchinson.

DR. HUTCHINSON: Good afternoon, Michelle.

MS. SWENARCHUK: Madam Chair, since several parties indicated that the subject of Dr. Hutchinson's expertise is an issue for them in the statements of issue, I will lead him through his curriculum vitae in more detail than I would have otherwise done.

DIRECT EXAMINATION BY MS. SWENARCHUK:

Q. You have your curriculum vitae?

A. Yes.

Q. Now, I understand from page 2 of the CV, Dr. Hutchinson, that you are a full Professor in the Department of Botany at the University of Toronto?

A. That's correct.

Q. And that since 1978 you have also been cross-appointed a Professor of Forestry at the University of Toronto?

A. That's correct.

Q. And that since 1969 you have been a founding member of the New Institute for Environmental Studies at the University of Toronto, and I would ask you to explain to the Board the purpose and fuction of that institute?

A. Well, the institute for environmental studies at the University of Toronto, it's a multi-disciplinary institute whose primary function --

Q. You will have to proceed slowly enough for them to take the notes that they want to take.

A. Its primary function is graduate education and research. So it's housed on campus at the university, it comprises - is that slow enough - it

comprises faculty members, graduate students from across the campus, particularly it houses them from botany, zoology, geology, geography, the law faculty, the various departments of engineering, anthropology, political science, economics sort of on and off, but primarily probably the first eight items I gave you there are the major faculty involvements in it.

It runs courses, it has a lot of research projects which is generally multi-disciplinary. It has paid a lot of attention to issues concerned with the Great Lakes, water quality, heavy involvement in aspects of air pollution both within Metro and within the province, it's hard working groups concerned with oil spills in the Arctic and in the St. Lawrence system.

It's currently got some work going on on forest decline and it's had involvement with various aspects of municipal waste management and it has a working group on salt applications and parts of salt on the natural eco-systems and on the Great Lakes.

So that probably gives you some idea of the sort of breadth of the things it looks at.

Q. Now, on page 3 of your CV - I don't intend to go through every line, Madam Chair, but those that I think could use some underlying - we see that in

1983 you received the George Lawson Medal of the Canadian Botanical Association for outstanding and continuing research into anthropogenic stresses on ecosystems, and I wonder if you could just indicate the work -- the area of the work for which that award was given?

A. Well, it was really for looking at responses of eco-systems to stresses which were generated from humans activities, particuarly the work that I worked -- that I had been involved with was concerned with air pollution, effects on forest systems, effects of heavy metals, discharges from smelters and things of that kind.

Obviously, a lot of the work that I was doing in Sudbury was involved in that, and making comparisons of how different types of forested ecosystems and tundra ecosystems responded to stresses. So it involved work in the Arctic, the boreal forest, the St. Lawrence/Great Lakes forests and so on.

Q. And in 1985 you were elected a fellow of the Royal Society of Canada. Could you explain for the Board exactly what is the Royal Society of Canada?

A. Well, there's two views of that. Some people think it's a rather fossilized club of eminent scholars from across the country, but I prefer

to think that it's a fairly dynamic group of scholars who seem to elect -- well, they elect new fellows, so it's a little incestuous in that sense.

I think there's two elected each year within the plant sciences and probably two within the animal sciences, but it involves humanities and it has a Quebec branch. It believes - and I suppose I believe - it is a distinguished group of scholars and it tries to do good things.

Q. Under your listing of international committees on the same page, paragraph (e) indicates that with regard to the Royal Society Committee on Climatic Changes and Biological Effects you have been -- you are the Chairman of the Terrestrial Effects of Climatic Change group for Royal society, and I wonder if you could expand on what that work entails?

A. Well, the Royal Society in the last ten years has attempted to take a pretty modern view of things and to be, if you like, socially responsible in the Canadian context.

It has had studies into lead pollution, it's had a major report on AIDS, it has got a heavy commitment to studies on climate change, and the way it has set us up is it -- the principle studies are scientific actually, though in fact they are now going

into the humanities.

They've organized them into three groups scientifically which it can -- Canadian geographic areas according to what we felt were the major areas, geographic areas of concern. So Canada has a large polar region, so there is one group which is really a polar Arctic research group which is supposed to report to the Royal Society and to the federal government on the likely impacts of climate change, the probabilities, what sorts of changes might occur and things of that type.

It has one which is concerned with marine and oceans because, again, we felt that -- I didn't personally feel this but anyhow, it was felt that the marine and oceans was a very important component of the Canadian involvement. It is an area where we are going to have significant changes in ice and things of this kind, water levels, and we needed to know a lot more about it.

Then basically having cut off the Arctic regions and all of the marine and oceans, there was the rest which is the land mass and all of the fresh water, and that's the committee I'm in charge of. Such involves the forestry, agriculture and fresh water systems, as well as all of the natural eco-systems.

Q. Could you indicate some of the other members of this committee?

A. Of what, of the terrestrial committee?

Q. That's right.

A. Well, there is Gordon Baskerville who is Dean of Forestry --

Q. He is known to the Board, Dr. Hutchinson.

A. Okay. Then there is David Schenley who is a limnologist from -- well, he works in northern Ontario actually --

Q. Limnology --

A. He's a limnologist. Very eminent scientist. There's is Mr. Gorham who is a plant ecologist from the University of Minnesota, there's Jim Harrington who is with the Canadian Forest Service and who is interested in climate change with respect to forest systems, there's Peter Dillon who is with the Ministry of the Environment in Ontario and another limnologist.

So we have a balance and there are some agriculturalists. There is John Stewart from the University of Saskatchewan who is a microbiologist interested in -- particularly in nitrogen/nitrification

processes and agricultural systems.

There's Bob Stewart from Ottawa who is with Agriculture Canada and his expertise is in modelling, really modelling crop productivity and yields with respect to changes in climate. He's eminent for a lot of the work he did in terms of modelling changes in wheat yields an wheat probabilities with respect to increases or decreases in temperature.

Q. What is your role as chair of the committee?

A. Well, it is sort of a brain storming session. With that group, we are supposed to write reports, we produce reports on what -- the people come together about twice a year and we have particular tasks that we attempt to address. We've been trying to develop the evidence of -- look at the evidence that temperatures are changing in the Canadian context and then a report will be produced for the Royal Society on particular aspects.

Q. Now, on pages 4 and 5 you have listed conference organizing and editing. I don't propose to go through that list.

Then on the bottom of page 5, we see a listing of scientific journals for which you are a

regular reviewer, and I take it that includes science and the Journal of Applied Ecology and the Canadian Journal of Botany and the Canadian Journal of Research and also that you have written for Nature which is not on the list?

A. Well, I review for Nature.

Q. You review for Nature --

A. --but I do review for Nature.

Q. And on the next page also, I underline environmental conservation, soil science and Ambio which, I understand, is a publication of the Swedish Academy of Sciences; is that correct?

A. That's right, yes. The ones probably most relevant to what we are doing here with FFT would be, I guess, the Journal of Environmental Quality, science and nature and the Canadian Journal of Forestry Research. Some of the others are concerned with agricultural or water pollution which is not an issue.

Q. Would it be correct to say, with regard to your international consultancy, the subject area has generally been environmental stress and ecosystem response?

A. That's right, yes.

Q. Is it correct then that you have consulted in the United Kingdom, Germany, Sweden,

Czechoslovakia, Norway, Poland, Venezuela, and as well have worked in Canada in the Arctic boreal from 1971 to '86, particularly the black spruce boreal, in the Sudbury area from 1968 to the present, and in the northern Ontario boreal forest from 1976 to the present and that you have been concerned with studies related to the sugar maple for the past six years?

A. Yes.

Q. I understand that in addition to the matters listed on the CV, that you have an ongoing commitment to Canagra and I wonder if you could explain what that is?

A. Oh, yes. Well, that's an industrial Canadian chemical manufacturing company and I'm involved with them in terms of experiments on attempting to alleviate some of the problems of sugar maple decline by specific fertilizer applications to forest systems, especially sugar bush, whether it grows, we have concern with the trees.

It's a complex project actually and my involvement is really as a scientific advisor, but it's complicated in the way -- we have been attempting to look at ten different sites across Ontario, Quebec, New Brunswick and Vermont and which we will all agree to do all the same things all at the same time with complete

protocols as to analyses and so on.

So that we are using the Canagra products to see if we can alleviate these problems and we are trying to make sure that it's an absolutely fair test of what's going on. So it's a very complicated sort of the experimental design.

Q. And with regard to both your research endeavors and awards and publications, I understand that the general focus of your work has been on the impact of anthropogenic stresses on ecosystems, both aquatic and terrestrial and their response?

A. That's right.

Q. Without going further through the list, since we see frequently references to toxicity, acidification, also effects of metals and acidification on mycorrhizae of boreal forest tree species, that is paragraph (c) of page 8; paragraph (g), commonalities of ecosystem response to a variety of stresses, sulphur dioxide, acidification, oil, fire, cold and wind; paragraph (k), impact of acid rain on foliage including boreal forest species; paragraph (l), sensitivity of boreal forest species to acidification; (m), studies on sugar maple decline in Ontario and Quebec, and I would refer the Board also to page 8, paragraph 15, on page 10, particularly paragraphs 22 and 23 and then the

publication list. I won't go through the list.

Could you just explain, Dr. Hutchinson, how the work that you have detailed here assists you in assessing ecosystem responses to timber management activities, particularly logging?

A. Well, I suppose what this is saying is, I have worked for a long period of time in the field in natural ecosystems and in managed ecosystems and I'm familiar with -- well, my interest and my expertise, I guess, is in examining how these ecosystems respond to different types of intervention, both natural and man-made interventions.

Obviously, particularly I've been concerned with air pollution, but we've made a lot of comparisons with other types of interventions and I've written on it and so on.

Q. And as a reviewer for the journals that we referred to, are you familiar with forest management related literature, scientific literature?

A. Well, it depends on what we mean by forest management related literature. The scientific aspects of it, yes, I would think I am.

MS. SWENARCHUK: On that basis, Madam Chair, Mr. Martel, I propose to request that Dr. Hutchinson be qualified as an expert in botany and

applied forest ecology with particular reference to the response of the forest ecosystem to stresses and disturbances.

MR. CASSIDY: Madam Chair, I would just like to advise you of my position on the matter.

I was one of the parties who raised this in the statements of issues and I am content, after hearing what I have heard this morning and this afternoon in reviewing the matter, that he can give evidence as indicated Ms. Swenarchuk; that is, botany and applied forest ecology.

However, I do have some concerns about the nature of his expertise as it relates to what he has written in his witness statement. However, rather than taking what will probably be a lengthy period of time to deal with this issue now, I may cross-examine the witness when my turns comes on the nature of his expertise and his qualifications in order that at the end of the day the Board is better able to consider and compare the weight that should be given to his evidence in light of all of the other expert evidence that the Board has heard and will hear.

MR. FREIDIN: Madam Chair, I echo Mr. Cassidy's remarks. I, too, would want to explore that area during the regular cross-examination in the same

fashion that was done by Forests for Tomorrow in relation to witnesses called by other parties.

MS. SWENARCHUK: I think it would be logical, Madam Chair, Mr. Martel to proceed by commencing with the concept of ecosystem as it has been presented to you previously in the evidence and as Dr. Hutchinson would define it. We could begin, I believe, with Exhibit 414 which was Panel 9 of the MNR's evidence - I believe you have this as well, Dr. Hutchinson - in which at page 16, Mr. Armson provided a definition of the term ecosystem.

We will use the witness statement as well, Dr. Hutchinson, which is this one. (indicating)

A. Okay.

Q. And we will also be looking at Volume 74 of the transcript at pages 12,555 and following.

Now, you have the volume of transcript as well, Dr. Hutchinson?

A. Sorry?

Q. You have the volume of transcript, Volume 74, I believe you have in front of you?

A. Yes.

Q. If you turn to page 12,555 please.

A. Okay.

Q. Now, on page 16 of the Panel 9

witness statement, Mr. Armson indicated that:

> "Forests can be viewed as ecosystems; that is, any complex of living organisms with their environment that we isolate mentally for purposes of study. The essence of this organizational concept is to endeavour, to the degree possible, to put an organism into the context of the processes to which it is subject or contributes and into context with other organisms in an objective and quantifiable manner. The major components forming the forest ecosystem concept are shown in Figure 2."

And we will see if we look at Volume 74, page 12,555, lines 1, 2, 3, 4, 5, that when I questioned Mr. Armson about this he indicated that this definition is a quote from Tensley and also it is the definition that is employed in the forest terminology that is used throughout the world as the definition.

Now, Dr. Hutchinson, do you agree that this is the current definition of ecosystem that is used in science?

A. The terms of the definition?

Q. Yes.

A. I think that would be quite rare for that to be.

Q. And how would you define the concept of ecosystem?

A. Well, it's just a concept, as you say. Ecosystems really, I think, are taken to mean they are plants and animals of their community, together - and this is really the vital piece - with all of the physical and chemical environment and it has to include all of the processes, the interconnecting processes which by nutrients and energy is recycled and flows throughout the system.

MR. MARTEL: Could I just ask Dr. Hutchinson to repeat that.

MS. SWENARCHUK: You will have to slow down, Dr. Hutchinson.

MR. MARTEL: My shorthand isn't...

THE WITNESS: Sorry. Well, an ecosystem, I think, to myself and probably to most biologists these days means the plants and animals in the community, that includes all of the microbial organisms and it includes the physical and chemical environment in which they occur, and that obviously has to include atmospheric gases and soil solutions and soil atmosphere and so on, and then most vitally includes

the processes which interconnect all of these. So it involves the pathways of energy flow through the system and the nutrient cycling within the system.

Now, that's a rather cumbersome definition, but that kind of encompasses the whole thing. Really, it's like if you are trying -- it's a little bit like Metro Toronto. That will be the ecosystem and it will be shortchanging it to simply photograph all the people or all the buildings and forget all the transportation that works and all of the energy requirements we have much. So the entire complex of living together within the city would be more like an ecosystem.

MS. SWENARCHUK: Q. And would you give some examples from the natural world of types of ecosystems?

A. Well, if you turn to any textbook, you will find ecosystems listed according -- basically to the kinds of communities in which you can virtually pick out some of the dominant plants and animals, sort of forest ecosystems and then subdivided into boreal forests, hardwood, deciduous forests and so on.

Q. Why did you indicate that the Tansely definition is, I believe you used the word rare?

A. Well, I don't know how -- maybe I

shouldn't use the word rare. My own particular thesis actually involved looking at some of Tansley's work.

This is sort of an aside, but one of his most famour papers was a paper he wrote in 1917 on competition and it is a terrific paper, but Tansley was working -- he was a really eminent ecologist, but he was working before all of the discoveries about nutrient flow and energy flow were made and those started from about the 1940's.

So Tansely was working in a -- he was one of the leading people in a situation which we didn't know a lot of the things we know now. So I just say it is a rather old definition of ecosystems, a rather static definition perhaps.

Q. On page 17 of Mr. Armson's witness statement, the next page, there is a diagram of the major components of a forest ecosystem.

Now, would you agree that that diagram illustrates the major components of a forest ecosystem?

A. Well, it has got some of the components in the ecosystem, but it doesn't have any of the processes. It's -- well, Dr. Armson is a soil science, so it looks like, you know, a section through the soil with some of the trees attached which is a part of it, but it doesn't involve any of the processes

which are another vital part of it. It doesn't indicate the interactions.

It's actually -- I have to say it looks a bit like a forester's view of ecosystems. I suppose that's how it is, but it's sort of the above ground parts of the trees and some of the soil. I think life is -- it's actually a lot more complicated than that. This might have been merely illustrative.

Q. If you were to illustrate major components of a forest ecosystem, what other components would you add to the diagram?

A. Well, you would have to indicate the -- you would have to get into processes. So this means that you've got to consider energy flow and nutrient cycling.

Q. Thank you.

A. There are a lot of others, but those, you know, those would be vital.

Q. Now, on page 18 of this witness statement, Mr. Armson talked about types of knowledge a practitioner would need, and rather than paraphrase his words, I would ask you to read the first complete paragraph on page 18 which begins:

"In certain circumstances..."

A. "In certain instances..."

Q. I'm sorry. "In certain instances...."

A. Okay.

Q. Now, I had a discussion about that paragraph with Mr. Armson and I would like you to turn to page 12,564 of the volume of transcript.

A. Okay.

Q. And without reviewing the previous pages, I can indicate that our discussion of that concept lead to a discussion of mycorrhizal fungi in the forest and at the bottom of page 12,563, the question was asked:

"Let's return to the situation with mycorrhizae which he know in general exist. They are ubiquitous in our situation..."

Sorry, this is an answer.

"So decision concerning the activities on forest trees can be made I believe without really being concerned about the individual and specific relationships between the mycorrhizal fungus and the root of the trees that we are dealing with."

And further, the question was asked:

"Might that not have a significant impact on the capacity to regenerate that site?"

And the answer was:

"There is no evidence that it does in our conditions."

And further at page -- on the same page at line 21 and 22:

"There is nothing to indicate that they are absent."

On page 12,565, carried over from the previous page, the question was:

"In a forest management practice which tended to damage or eliminate them could affect future forest growth; could it not?"

Answer: "I'm not aware of anything in the literature or any evidence that applies to the area of our undertaking where such a situation has existed or could exist."

Now, I would like to you ask you first to review briefly, for the purpose of the Board, the role of mycorrhizal fungi in forest growth, relatively briefly?

A. I was just saying that -- I was just

thinking this could be a bit painful for everybody, but anyhow, mycorrhizal, as I'm sure you must have heard before, are the symbiontic; that is, the positive relationship between roots of plant --

Q. And slowly.

A. And slowly. Between roots of plants and fungal associates. The fungal associates that associate with these roots are very specific; that is, a certain tree species will only have certain types of fungi with can associate with it.

The association is apparently mutually beneficial. The fungi increase the surface area for absorption from the soil very substantially. Not only that, nearly all of the literature indicates that they in addition cause -- allow the trees to take up large quantities of phosphorus and, hence, the ability to take up some essential elements.

In this context, phosphorus is a very important one, and the other one that -- in the boreal forest has been indicated and from sites in Scotland is nitrogen uptake. So two of the big three micro-elements for plants have their ability for extraction from soils enhanced significantly if you've got mycorrhizal associates at the roots. A lot of people think, in fact, that they are vital to -- and

tree species, both in the boreal and in the hardwood systems.

The infection process, as Dr. Armson pointed out actually, takes place quite early on in the life cycle. So shortly after the seeds germinate in the soil or after seedlings germinate, the infection will take place through spores which are present in the soil which germinate simultaneously or from roots of already infected trees.

If we don't have this infection taking place, then it is at least conceivable that the trees could be in some nutritional trouble. They certainly are very important where you have nutritionally poor sites. The only place where mycorrhizae seem to be, if you like, of less importance is where you have nutritionally adequate sites or when you actually fertilize, in which case the mycorrhizae don't seem to like it, the tree no longer needs them and seems to...

But as long as you have nutritionally poor sites, which we have throughout most of the boreal forest, indeed most forests actually, then mycorrhizae are important. They also, of course, occur with grasses and so on.

They're rather sensitive. You've got to have conditions right for infection to take place.

There are instances where mycorrhizal fungi don't occur in the soils because the soils have been sterilized by pollutants or by acidification, and in cases in the United States they deliberately infect pine seedlings before they put them into the ground so that you artificially infect them, put them in and you get a very substantial increase over non-infected ones. You also get a substantial increase in survivability of the seedlings.

Now, it's my understanding in Ontario that we actually deliberately infect quite a lot of the seedlings that are planted out because of the possible problem of sites not being adequate.

A lot of the mycorrhizal fungi are sensitive to acidification. One of my concerns about clearcutting on a large scale is that this is -- the tendency is to create acidification. So there is some concern as to whether we have adequate mycorrhizae sitting out there ready to take over and infect the roots of these trees.

They are very sensitive to increases in aluminum concentrations, there is a toxic element in the soils and aluminum goes into solutions under conditions of increasing acidification. So there's a possible scenario in which we would have problems.

Now, I do believe with black spruce these problems have been recognized because for certain sites they are actually -- there's work going on in Sault Ste. Marie on inoculating black spruce seedlings and finding the best ways to inoculate them and see what the benefits are. One of my students, ex-students is working up there on this project with Canadian Forest Services.

Q. Thank you. Now, I would like to turn to another concept introduced in Mr. Armson's witness statement and that is the concept of forest resilience and that's introduced at page 14 of his witness statement.

In discussing this subject, we will also look at the evidence of Dr. Methven which I believe you also have, Dr. Hutchinson. Members of the Board, that's to be found in Exhibit 1121.

Now, we will see from the second paragraph on page 14 of Mr. Armson's evidence that it's his view that:

> "...another characteristic of forests in Ontario is that they are remarkably resilient and capable of adjusting to disturbances to which they are subjected. Historically, glaciation was the most

profound disturbance to alter this part of the world in the past 10 to 20 years. Ontario's forests now largely exist on the detritus and erosional residues from that period."

And then rather than take the time to turn to it, I will just read the relevant excerpt from the transcript. This is again, Madam Chair, Volume 74 at page 12,571 when I was discussing the question of forest resiliency with Mr. Armson and he said:

"Maybe they are not infinitely resilent, maybe not infinitely, but what I am saying very clearly, I believe, is that taking the area of the undertaking and the vast -- the variety of forest and conditions that exist, that in fact that forest -- that totality of forest is extremely resilient as witnessed by the massive disturbances that has undergone over many hundreds if not thousands of years."

Then with regard to Dr. Methven's evidence, again I will just refresh our memories by reading it. This is from Volume 194, at page 34,300, lines 7 to 13 and he testified:

"However, in Ontario, as you know..."

This is in the transcript rather than in his witness statement, Dr. Hutchinson.

A. Okay.

Q. "However, in Ontario, as you know, fire is a very dominant part of the landscape. The plants and other species have fully adapted to it and have evolved to survive in the fact of this environmental disturbance and the net result is they are highly resilient and able to withstand all kinds of disturbances."

Now, would you indicate for the Board, Dr. Hutchinson, your opinion of the concept of resiliency as applied to Ontario forests?

A. How do I view resiliency?

Q. Yes. Would you agree with Dr. Methven that they are able to withstand all kinds of disturbances?

A. No, I wouldn't. I think the things to bear in mind is that plants and animals of course are adapted to some generally rather broad but limited range of stresses, so they can survive these stresses.

It's very important to recognize that the

stresses that they can survive are the ones that they used to. So if during their life cycle in a recurring way we have fire recurring, then you can anticipate that species which occur in fire prone sites will have adaptation which will enable them to survive fire, but you can't say from that that we can, therefore, come along with all kinds of stresses and they will survive that, too.

So there are limitations and if you come in with some other stress, it might or might not be that they can survive them, but the chance are rather good you will finish with perhaps another plant community.

Even with respect to fire, some can survive it; that is, head on, and others are post-fire species and will come afterwards. The example of glaciation, though, probably that wasn't the great one because I think the way -- the very sensible way the plants dealt with that was they got out of the way. When the glaciers came through -- I mean, Toronto had 300 feet of ice where we sit. So there really wasn't nothing there that.

I think what we are talking about is the ability to invade once the ice retreated and, of course, the boreal forest with its cold temperature

tolerance and its ability to grow in short growing seasons has been able to do that, but it wasn't that it could survival glaciation.

Q. Are there any other conditions to which, in your view, the boreal forest is resilient?

A. Well, it's resilient to all the stresses that normally and naturally occur in the boreal forest. As I said, these include short growing seasons, severely low winter temperatures, quite substantial snow cover.

They've got to be able to grow and survive with about a four-month growing season unless they are further north. Generally speaking, they are growing on soils which have been derived only over the last 10- to 12,000 years and at least that's why we've got granitic rocks in the precambrian shield, that hasn't allowed any enormous depth of soil to develop, so that they would have to be able to survive under those shallow soil conditions.

Where we've got glacial tills and so on, obviously they will have better opportunity. The Clay Belt would be another one, that's where...

I guess I'm just saying that you can't predict in advance necessarily what stresses they can survive from what goes on at the moment, you have to

find out.

Q. I think you should perhaps clarify that.

A. Well, there are always surprises which occur. Some species may have some greater tolerance than others for particular sets of circumstances.

Q. Now, one last subject area arising out of Mr. Armson's witness statement is the question of overmature forest and that arises in the diagram on page 20 of his witness statement of which the last element at the bottom of the page refers to overmature forests, and too led to a discussion in the transcript which is at Volume 74, page 12,576 and following.

The former Chair of the Board became involved in this discussion as well, and he asked at page 12,576, lines 8 and 9 and following:

"But an overmature stand or forest is not considered in both parlances, both the ecologist and the forester, as the healthiest forest; is it?"

And Mr. Armson replied:

"Well, I can't speak for the ecologist, but certainly the foresters would consider it a less healthy condition."

Now, in your view, is an overmature forest an unhealthy forest?

A. Well, I don't want to get into nitpicking, but I want to know what we are actually talking about in terms of overmature.

If we are talking about a forest which has a high percentage of old trees; that is, trees which some people might be surprised if it is still there because they're really quite ancient. If that's overmature, then that certainly to my mind is not necessarily an unhealthy forest.

I don't think a natural scientist, ecologist would simply -- we do not accept the concept that things that are unhealthy are overmature. It's all part of a natural process.

If we take jack fine, for example, the normal sequence of events is that a fire comes through at some stage during the life cycle of the individual and that stand, that population of jack pine replaces itself. If the fire delays in coming through, maybe for 200 years, then some of the trees get old, but others may die along the course of events and other species are intruding into that forest in the understorey and are beginning to build up things like balsam and some of the spruces might be coming in.

So if we delay the normal intervention which will be the fire, if we keep on delaying that, if we don't simply finish it with bad ground, a lot of ancient trees hoping to die, there is a natural replacement taking place of other species which are able to get into this understorey.

If we simply ban fire, if we are ever clever enough to do that, which I don't recommend, but if we ever did that, then we wouldn't simply lose jack pine stands completely, we would have a progression through jack pine into other forest species and it would be, to my mind, a healthy, new and different forest.

Q. Now, the Chairman at the time went on to say at line 22 of the same page of transcript:

"If you had a forest that was overmature or a large part of it without the younger forest growing up behind it and reinvigorating what was there, even in ecology terms that wouldn't be as good a situation."

Now, with regard to the description you have just given of an over-mature forest, is it the case that overmature stands typically do not have younger forests growing up behind it?

A. No. I mean, that's a hypothetical case that we prevent anything else coming in and just wait for the trees to die. That's just a totally artificial situation.

Q. Now, as an introduction to testimony I am going to ask of you with regard to nutritional consequences of harvesting, Dr. Hutchinson, would you please provide the Board with an overview characterization of the boreal ecosystem with regard to particularly nutrient availability? An overview of the system.

A. With respect to which system?

Q. The boreal ecosystem.

A. The boreal ecosystem.

Okay. Well, in all ecosystems, obviously there has to be nutrients recycled, there has to be a phase in which nutrients have been involved in the organic matter, in the living issues of the plants and animals that return to the soil and over time, sometimes quite rapidly in tropical systems, sometimes more slowly in the boreal system, these nutrients are then made available again.

The normal processes by which they are made available is microbial decomposition of the needles and twigs and things which fall on to the

surface and the animal bodies. This is a -- you might say it's a fairly slow release system.

In the boreal system generally, it runs a little bit -- there is a little bit less release each year than falls onto the ground surface, so you get a slow accumulation of organic matter. So if you walk into a spruce forest you will see needles on the ground. If you walk into many of the deciduous forests around here, if you go in right now there is a pile of leaves on the ground, if you go in next summer, those leaves are completely gone. So the system is keeping pace with the nutrient release.

So in the boreal it runs -- it's a little bit slower mainly because of the -- well, there's three reasons. Because of the lower temperatures and the shorter growing season; also, to some extent, because of the more natural acidity of those systems; and also because of the nature of the litter coming down which is, generally speaking, rather less easily decomposed from your coniferous species and from your hardwoods. There are some exceptions to that.

So the essential part of this is that in a healthy ecosystem - now we will talk about healthy - in a healthy ecosystem, we can define it as one which is not leaky; that is, there is not a continuous

leaking out of nutrients from the system. It closes itself from an initial stage of invasion of a site. It closes itself until the nutrients are being rather tightly bound and not leaking out.

One of the ways we can detect leakiness is to look at a watershed. That watershed is simply a catchment area and you can monitor the leakiness out of it because you can measure the chemistry of the streams. So the streams will drain your watershed. If you set up monitors and you follow the chemistry -- if you come into that leakiness system, so you monitor it before hand and you pave the levels and the flow rates, you work out how much is disappearing each year, it's a rather low percentage of the amount that's involved in the cycling. So there is a little bit of leakiness, but it's very little.

If we come in and do disturbances of different kinds, then one of the things that happens in the ecosystem is you get a big signal. You begin in the streams and the lakes and so on to detect leakiness, there's increases in some of the essential nutrients and especially with changes to the nitrate, sometimes the sulphite levels, chloride, things of this kind.

Q. Dr. Hutchison --

A. Am I going too fast?

Q. No, I don't believe you are going too fast.

Could I just ask you, would you characterize the boreal ecosystem as nutrient rich or nutrient limited?

A. It's all relative, but the boreal forest is nutrient limited.

Q. And would you expand on what you mean by that?

A. But, of course, there is a lot of variability through the boreal. What I mean by that is, it's not growing at an optimal rate with respect to nutrients; that is, if you carry out nutrient additions, I can pretty well guarantee that at any site you will see gradual increase growth rates.

Q. And with respect to what nutrients particularly is it limited?

A. Well, the two big ones I think are the nitrogen and phosphorus, especially nitrogen. And one of the reasons that the boreal is limited in this sense is it's only had 10,000 years of soil development.

If you compare that with the tropics, they've got millions and millions of years in which

there has been no glacial interventions.

So part of the snag is that we have -- where we started with bedrock in the boreal system, we've got very shallow soils, many of these rocks have been granitic rocks and, therefore, they weather very slowly. There are exceptions where you've got glacial material left behind like clays, sandy tills, outwash, plains and things of this kind.

The sand doesn't have much capacity to hold nutrients, so sandy soils are generally characterized as nutritionally poor. So we have shallow soils over much of area, we have substantial amounts of sand deposits which, again, are nutritionally poor and then we have the Clay Belt which is nutritionally quite rich.

Q. Now, you mentioned --

A. It's a bit difficult just to say the boreal is nutrient poor or whatever, but certainly compared to the hardwood systems, the hardwood forests say from the Canadian/U.S. border down through Georgia and so on, the nutrient availability in those soils is much greater than in the boreal systems.

Q. Now, you mentioned that with regard to nitrogen and phosphorus there are limitations. What about with regard to potassium?

A. Potassium is sometimes limiting, too. Now, what we are really talking about is one of the fundamental laws of plant biology; that is, the law of limiting factors. I guess it is true of animals, too, but things are held back by one factor or element at a time.

So that if you have a major nitrogen deficiency, it's such an important element that it doesn't really matter whether you have adequate manganese or something else because it can't get past that major block in the system.

If you then add nitrogen so that it can suddenly get past the block, and it grows quite well, and you've got a manganese deficiency backing it up, then it will be snagged again. It will slow down because it runs into the second part. We have a multitude of these potential deficiencies in much of our boreal systems.

Q. All right. Having dealt then with nitrogen, phosphorus and potassium, are there other elements which the boreal system can have only limited quantities?

A. Calcium, sometimes magnesium, potassium, nitrogen, phosphorus. I guess those are the major ones.

I did refer, I think, maybe in some answers to the interrogatories to some work from Sweden and some of our own work which indicates that other micro-elements can become limiting under certain circumstances and the ones that we have been observing in Ontario are manganese and zinc and in Scandinavia they have been finding manganese, zinc, copper and boron. So these are sort of second order problems that you can run into.

Q. Now, I wonder if you could just add any further explanation, if you would, to the Board with regard to the process by which nutrients are cycled within the boreal forest system with respect to atmospheric depositions in the form of rain, snow and dust deposition?

A. Generally speaking, that of course isn't quite a limiting component into the system. We have changed it a little in the last 50 years because we have got acidification deposition and it actually adds significant quantities of sulfate and also increasing quantities of nitrate.

Now, the nitrate is unfortunately delivered in the form of acid rain. Nitrate is definitely a beneficial thing for the forest and there is evidence from various places that the nitrogen

component of the acid rain is having some enhancement effect. Some experiments in Norway have shown that the nitrogen component has been good. It is a pity it is associated with sulphite and has a lot of acidity with it.

Q. Could you indicate the role of the various part of the trees? You mentioned the atmosphere proposition, that cycling process.

A. If we start at the top and go down, we've got atmospheric potential. On to the soil surface all the litter falls and all -- now, in coniferous systems, their needles live for a number of years, 4, 5, 6 years and some of the nitrogen especially tends to be removed from the needles over time. So by the time they drop, the tree is already clever enough to recycle some of that, also of course some is being leached out.

Calcium and magnesium and potassium get leached out, out of the needles. So the old needles, before it drops to the ground, isn't nearly as nutrient rich as the first year needle, but when it does get to the ground and -- it would also have been scrubbed by the rain and snow falling on it and that may cause some chemical changes.

Once it gets into the soil, in the

surface lawyers you have your maximum microbial activity. So there are all kinds of bacterial and fungal populations there just waiting to grab these goodies that fall to the ground.

Now, as I said, in the boreal system, ther speed in which they can act is limited by short growing seasons, low temperatures, frequently water logged soils, they don't work so well under --

Q. Would you explain what that means?

A. That means lack of oxygen. Okay, low temperatures, short growing seasons, those are the major factors.

Because of the acidity of many of the soils, we tend to have our microbial systems that release all these nutrients dominated by fungi rather than bacteria. That's a simple function of pH. I mean, the simple rule is that bacteria prefer -- most bacteria, there are exceptions, prefer the less acidic environments and they are rather better, faster at breaking things down than the fungi.

So we have a system that is a little bit on the fungal end of it and a bit slower for these various reasons. But eventually when nitrogen and calcium and whatever is released into the soil solution and if that's occurring in the springtime, then the

roots are just too glad to see it and they absorb this material. If they're unfortunate enough not to have mycorrhizae, they might not be so successful. So it is important that we have a very healthy, fully functional microbial population in the soil.

That microbial population is principally in the organic, what we call, forest floor and the humus layers immediately going into the mineral soil. So it's very largely confined to the organic components. That means, when we lose organic matter, we are losing a great deal of this potential for decomposition.

Now, if any of it is not picked up by the roots and returned to the leaves and the bark and the trunk and so on would be washed out of the system, maybe deposited lower down in the soil or some of it will be washed right out of the system into the streams and in the ground water.

MS. SWENARCHUK: This will be an appropriate place for a break, Madam Chair.

MADAM CHAIR: That's fine, Ms. Swenarchuk. We will be back in 20 minutes.

MS. SWENARCHUK: Thank you.

---Recess taken at 3:35 p.m.

---On resuming at 3:50 p.m.

MADAM CHAIR: Please be seated.

MR. CASSIDY: Madam Chair, I had the opportunity to have a brief discussion with Ms. Swenarchuk at the break and she advises me that there is a possibility that she believes the evidence-in-chief may finish some time tomorrow afternoon.

I note that Mr. Hanna is not present and it is my understanding he intends to participate since he filed a statement of issues to cross-examine on this panel. As you know, the order of cross-examination will have him going ahead of myself in the order and what I might suggest and why I am rising is that Mr. Pascoe make efforts to contact Mr. Hanna and advise him of the possibility that may be on for cross-examination tomorrow afternoon.

MADAM CHAIR: All right. Mr. Cassidy, I don't know where Mr. Hanna is, but would you be prepared to go on tomorrow afternoon if we can't get him here whenever Ms. Swenarchuk is finished.

MR. CASSIDY: No, I would not, Madam Chair, in the context of this order. It is my position that the parties in opposition should go in cross-examination following Forests for Tomorrow's evidence and, as a result, I would prefer not to go

inbetween Mr. Hanna and Forests for Tomorrow's case.

Simply put, it is the exact reverse of what happened when the Ministry was putting in their case and, as a result, it is my position, as it was Forests for Tomorrow's at the time, that all parties with a lack of interest should cross-examine the party leading the evidence first and then the parties in opposition to the person adducing the evidence would proceed.

As a result, it is my view that Mr. Hanna should precede my cross-examination since he indicated or his client indicated on the first day that they are in opposition; i.e., an allied interest of Forests for Tomorrow.

MADAM CHAIR: Well, certainly we've had this situation before and I think in fact we have split up the cross-examination of parties to accommodate down time if other parties couldn't show up.

I don't know what's going to happen with Mr. Hanna. We will try to get in touch with him tonight. Do you think you will be finished early in the afternood, Ms. Swenarchuk or...

MS. SWENARCHUK: I can't really assess and it is possible that I will take most of the afternoon or it may be earlier. I can't really assess

now.

MADAM CHAIR: How long is your cross-examination, Mr. Cassidy?

MR. CASSIDY: As I indicated in the scoping session, a day to two days.

MADAM CHAIR: I see Mr. Pascoe just joined us. Do we have any word from Mr. Hanna, Mr. Pascoe?

MR. PASCOE: No, I tried to get a hold of him.

MADAM CHAIR: We will try to get a hold of Mr. Hanna this evening.

MR. CASSIDY: Thank you, Madam Chair.

MS. SWENARCHUK: Madam Chair, my colleagues have brought to my attention two housekeeping issues. The first is that following my review of Dr. Hutchinson's CV and the comments from other counsel, we don't actually have your word on the transcript that he has been qualified in the areas of expertise that I asked, so I would ask for that affirmation.

MADAM CHAIR: Yes. We have qualified Dr. Hutchinson as an expert in the areas of botany and forest ecology and the Board will be hearing more questions about his credentials from Mr. Cassidy and

Mr. Freidin.

MS. SWENARCHUK: Yes, and that was applied forest ecology.

MADAM CHAIR: Applied forest ecology, thank you.

MS. SWENARCHUK: Secondly, that we have not given exhibit numbers to the two source books for Panels 1 and 1A and perhaps we could do that.

MADAM CHAIR: Exhibit 1408 -- how do you want to do this, Ms. Swenarchuk?

You have the blue book. Do you want that to be a separate exhibit and then we have additional articles that you submitted to put in the source book.

MS. SWENARCHUK: Those articles are all part of the source book, so they don't need additional numbers.

MADAM CHAIR: All right. And the source book for witness statement 1A is separate?

MS. SWENARCHUK: That's right. It's bound separately. I think it would make sense perhaps to give them A and B numbers again.

MADAM CHAIR: All right. Exhibit 1408 will be the source book for Forests for Tomorrow's witness statement No. 1.

MS. SWENARCHUK: 1408A would that be?

MADAM CHAIR: 1408A and Exhibit 1408B will be...

MS. SWENARCHUK: Source book for Panel 1A.

MADAM CHAIR: For 1A?

MS. SWENARCHUK: Right.

MADAM CHAIR: Why don't I have 1A? I have got 1.

MS. SWENARCHUK: It looks like this. (indicating)

MADAM CHAIR: All right, thank you.

We will find source book 1A and bring it with us tomorrow.

---Discussion off the record

MADAM CHAIR: We do have a source book for witness statement 1A.

MR. MARTEL: Is that your 1A? (indicating) We have two number 1As.

MR. LINDGREN: One is the witness statement.

MADAM CHAIR: That's the witness statement and this is the source book, it has got the articles in it.

---Discussion off the record

---EXHIBIT NO. 1408A: Source book for Forests for Tomorrow's witness statement No. 1.

---EXHIBIT NO. 1408B: Source book for Forests for Tomorrow's witness statement No. 1A.

MS. SWENARCHUK: Madam Chair, I think the hours tomorrow will be nine o'clock to four o'clock; is that correct?

MADAM CHAIR: Yes.

MS. SWENARCHUK: Q. Now, before we move on to another topic, Dr. Hutchinson, would you just take one moment to expand somewhat on the role and availability of nitrogen in the boreal forest system?

A. All right. Madam Chair, nitrogen is a little bit different to the other elements in that there is virtually none available from the original bedrock, so that you are not finding nitrogen in the bedrock of these materials.

There was, of course, with calcium, phosphorus and so on. There is a possibility of having mineralization taking place and have this recharged into the system over time.

With nitrogen, the flora, plants and ultimately for animals, most of it is derived from the inert nitrogen gas in the air. So that this has to get

into the soil through processes of microbial activity and it also takes place in association with the roots of certain legumes, beans and pea family plants, but a lot of it, as I say, is a microbial induced process.

The reservoir in the soils is principally in the organic matter. So as you have a breakdown of organic matter from decomposition, this nitrogen is released.

Now, if for whatever reason, you lose your organic matter from the soil completely, which I suppose that can happen, then you would have effectively lost almost all of your nitrogen and that would automatically become the No. 1 limiting factor, that plants simply could not sustainable themselves in the absence of adequate nitrogen reserves. So this relates -- this reservoir in the organic matter is very important. It's important also for phosphorus, but to a somewhat lesser extent.

Q. Now, Dr. Hutchinson, I am going to ask you to explain for the Board in summary form your concern with regard to full-tree logging in the boreal system and I will direct your attention first to a summary that you have provided on page 13 of your witness statement; that is, Panel 1. That may be useful to the Board.

However, could you begin with your concerns with regard to impacts of full-tree logging on nutrient availability?

A. Right.

Q. May I ask, I understand that since your witness statement was completed two other publications have come to your attention which could be of assistance in this matter; is that correct?

A. Yes. Well, perhaps I could come to those in due course. The concerns that I have expressed in this witness statement are ones which are quite widely held amongst forest scientists concerned with the nutrition of the forest and also concerns which are held by many plant ecologists.

The reason that we have these concerns to do with nutrient status, the focus is particularly here on full-tree harvest versus bole only or stem only harvest. So our concern is that the full-tree harvest and the whole-tree harvest, which we are not really into in this province, would and do take from the site substantial increased quantities of essential elements, essential nutrients--

Q. More slowly, perhaps.

A. --and that these are taken off site. In stem only harvests, the general pattern has been

that brush and slash is left behind, the canopy is not taken off site and it's really a kind of example of Murphy's Law, in that a high component of these essential elements happens to be in the foilage and, to some extent, in the twigs and branches and the bole itself, which is what we have traditionally been harvesting, has a significant lesser proportion of the hole.

The consequence is that we might increase biomass, total organic removal from site by full-tree harvesting and maybe from 30 to 120 per cent, and this is used for various purposes, but there is a disproportionate increase in the amount of nutrients taken from the site. And we are talking about several factors increased for certain elements and there have been a lot of studies done on this now.

These studies really started in the 1970's and they have continued right to the present, and Ms. Swenarchuk has referred to a recent publication particularly that I will draw your attention to which summarizes yet again the same concerns. It comes back basically to the same conclusions that I have come to from my own examination from the literature.

What we are really saying is that if we persist in a full-tree harvest system, particularly on

sites which are already nutritionally poor, then we are going to be removing from those sites too much nutrient to allow a successful second generation and subsequent generations.

So what we are really saying is that we will be faced with either a gradual degradation of the systems - and they have run into this in parts of New Brunswick already - or we will have to have longer intervals between harvest. And the general hope, I think, in the province is that we could have shorter rotations, but I certainly believe from the evidence that we will be facing longer rotations, our own successful rotations if this is persisted with.

As I say, much of it relates to the amount of nitrogen, calcium, phosphorus and potassium which are in the canopy and this is also, incidentally, true for both the hardwoods and for the softwoods. So we certainly feel, I certainly feel that in the hardwood case you have an even higher proportion in the canopy. So the worst situation from an ecology point of view would be to taking all the foliage of hardwoods off during the growing season and not returning that litter, that compost, if you can like, back to the sites.

MR. MARTEL: Could I ask a question?

THE WITNESS: Yes.

MR. MARTEL: Because of the annual loss of foliage in the hardwood forests, would the problem be as severe with full-tree harvesting there?

THE WITNESS: Well, there's a balance between the persistence of the needles and the amount that comes down each year, so they are retaining four or five years and each year they are dropping one of those years back. So it's a little bit different. The partitioning of it is a little bit different.

The more extreme situation is, if you like, sort of everything being delivered from the leaves on to the ground in the hardwood situation each year, so that's why it is worse. It all comes down at once and it's -- that will be a catastrophy to be taking those things off on nutrient poor soils.

The other side of the argument is that many of the hardwoods are on somewhat nutritionally richer sites, so then you have got to balance up how much of this can you take off against what mobilizable reserve have you left when you have done this and the decision seems to have been made, I think, in some level of ignorance as to how much would be taken off.

There are certainly reports with respect to calcium and nitrogen, and nitrogen I've referred to

as being a particularly critical situation, but calcium also. The studies that I have referred to in this witness statement from Nova Scotia, New Brunswick, from Ontario, from New Hampshire and those also from Scandinavia, all point in the same direction, that full-tree harvesting cannot be sustained and shouldn't be attempted on nutritionally poor sites.

So then, of course, we get into the question of what a nutritional poor site is if you accept this and that's a very important question for this province.

MS. SWENARCHUK: Q. And we will come to that question later in your evidence?

A. Right. Some of the reports from people in Ontario say that we cannot sustain full-tree harvesting from moderate fertility sites and, in fact, they recommend against attempting full-tree harvesting on moderate or nutritionally poor sites.

There seems to be at least from -- of course, you know, this is one reading of the literature. The Freedman report that I have referred to and Freedman's most recent writings comes up with the same sorts of numbers; that is, that we have a many fold increase in loss of calcium, nitrogen, phosphorus from site by full-tree harvesting compared to bole

only.

He feels that the potential replenishment from the sites for nitrogen and phosphorus and potassium would allow you to maybe run two or three generation of doing this, but he does point out that calcium data means that you are going to run into limitations in the first generation. And my interpretation of that is, if you have got a major limiting factor like calcium, the trees have to respond to that, they have to respond to it by inadequate growth.

That means a slow down in growth and either a longer rotation or an inability to grow satisfactory, and I think personally we are walking right into this at the moment by having moved so rapidly into full-tree harvesting. I understand more than 60 per cent in 1986/87, 87/88 of the province was being harvested by full-tree methods.

There's other aspects in comparing full-tree with bole only harvest. Where you put slash back onto the site, then there is -- this will decompose over time. So, if you like, you provided some of the nutrients back onto the site.

It's possible, where we're taking the canopy off to landings and removing canopy and

stripping on the landings, that if this material was returned from the landings, which may be difficult of course, and then spread across the site without getting into questions of further compaction of the site, if there were some way of getting that material back on to the site, we could mitigate this.

If we're burning it, which is what we're doing to quite an extent, burning it on the landings, if the ash could be put back on, anything to get some of that vital nutrient material back onto site.

Now, if we absolutely insist, for whatever reason, that we persist in this, then I think we have to start asking questions about fertilization. In agriculture, we would never dream of simply attempting to maintain high productivity without fertilizing it. Now, I know there are differences, there's a lot of differences between agriculture and forestry.

MR. MARTEL: How much fertilizer would you need if you are going to start to fertilize the forest? We'd have a new industry just producing fertilizer.

THE WITNESS: That's right. It wouldn't be Canagra, by the way. That would be an economically difficult thing to do. I mean, the application, the

methods of application and the costs are pretty prohibited. I believe no fertilizer is used at the moment in this province in terms of --

MS. SWENARCHUK: Q. Could you just indicate, Dr. Hutchinson, and I believe you've indicated this in an interrogatory response too, are there ecological disadvantages to - aside from the economics ones - to the use of fertilizer on forest land?

A. Well, there are.

Q. What would those be?

A. Well, first of all, that you've got to the fertilizer on in the right form, preferrably in slow release form at the right time.

If we are dealing with clearcuts, then the amount of root systems that are available immediately for taking up this fertilizer, if you apply it immediately after cutting, there is a limited amount of reserves there, so you are going to have to really time the fertilizer applications to the silvicultural treatments.

And then, as I say, the pattern of uptake is that there be a limited amount taken up into the saplings and seedlings that you might be planting on the site and then this will increase. There has been a

lot of work done in Sweden on this and it's a difficult thing to achieve; that is, to have fertilizer applications, especially once-only fertilizer applications that doesn't lose a lot of the fertilizer from the system because what you are trying to do is put enough fertilizer on for bigger trees than you are planting and then try and avoid run off from the system. So you can certainly get into problems of pollution of streams and lakes from it.

It's a difficult thing. Personally, it seems to me, from an ecologist point of view, that it makes much more sense that we don't take this material off site and create the problem at the beginning, or that we simply recognize that this is not an acceptable way to be dealing with nutritionally poor sites and you don't cut them.

Q. Dr. Hutchinson, with regard to fertilization, is there any concern regarding eutrophication of nearby -- of water sources?

A. Yes, there is. Eutrophication means nutrient enrichment of waterbodies and it's like applying fertilizer to the lawns around Toronto; much of that sadly finishes up in the Great lakes. It finishes up in Lake Ontario. There is run-off from the system, it goes into solution and you probably put on

more than the root systems can cope with at that time and some of it finishes up in the lakes.

We are adding significantly to the nitrate loading of Lake Ontario, big as it is, from fertilizer application and, of course, run-off from agriculture land.

Q. Is there any concern with regard to too high nitrogen level effects on saplings?

A. Well, you know, I suggested that acid rain wasn't entirely bad, that some of the nitrogen components could be beneficial.

One of the concerns that's been expressed about the high nitrogen loading that were getting into the Adirondacks, for example, is that this is believed to be leading to -- the trees are not sustaining the low temperatures of winter; that is, they are not developing winter hardiness because of the quite high nitrogen that is going into some of those systems, and the similar experience from Norway.

So that's at a stage in which, you know, the two or three reports on this. I wouldn't say it's generally accepted, but it's a possibility that we could create non-hardened -- trees which are not able to adequately supply...

But that's very problematic, that area.

I think eutrophication is a clear possibility.

Can I give an agricultural parallel. So many parts of central Ontario, when they were first cleared by enthusiastic pioneers, were on sites which simply could not sustain agriculture. If you go around in the bush, in the forest you will find old fences and things in fully mature forests and these were farms which were abandoned, and the general reason was that the soils were shallow and nutritionally inadequate.

After they had run those nutrients down from succession, maybe 10 or 15 years if they were lucky, of potatoe crops and so on, there was -- unless they could bring chemical fertilizers in, they couldn't be sustained.

Now, my great concern about going on to nutritionally poor forest sites is that we could run into the same sort of problem in which we finish up the sites which simply cannot be sustained for forest productivity and for all the other purposes.

MR. MARTEL: Would we have to have a greater database then to work from if one is going to follow what you are suggesting in knowing the sites that are nutrient marginally, nutrient poor, those that are rich? I don't mean in some kind of overview, but in a very specific way in order to avoid this

occurring.

THE WITNESS: Well, obviously there will be a good deal of debate about exactly where you draw the lines. I think probably the two extremes, nutritionally rich and nutritionally very poor, we could get pretty rapid agreement. It's how far you go from the nutritionally poor, how far you move towards the moderate that may be debateable.

Now, as I say, this Timmer paper that I've referred to in fact recommends that we not be cutting on moderate sites. There's a number of different systems for sorting out forest nutrition or site nutrition. I certainly believe that we should be looking at the nutritional status of sites before we go in and cut them. I think that's most important.

Part of this can be approached from the point of view of the vegetation that's growing there; in other words, you can use the plant communities and associates as a kind of indicator of nutritional status.

The ecosystem classification system that the Ministry of Natural Resources has been developing, first of all for the Clay Belt and then more recently for northwestern Ontario, I think is a very useful lead in this direction, but it needs to be applied on a

site-specific basis, and one of the snags with it at the moment - I think it is a very fine effort - but one of the snags with it at the moment is that it has got the vegetation on one axis and the soil another, and maybe northwestern Ontario thinks it's a little too complicated to use in the field. I think it classifies into 38 different units.

But leaving that aside, it needs to be, if you like, set against nutritional status. So there is another step needed which could be done; that is, to look at the relationship between vegetation and soils and then put in the other axis which is nutrition and then you would have a basis for doing your site specific work.

There's a number of people who have looked at methods of assessing soil chemistry using different extractants. A lot of that gets into terrific arguments, especially amongst the soil scientists, but there is nevertheless a kernel of agreement that comes out of that. So we certainly should be assessing the sites, in my opinion, in terms of the soil chemistry and using methods with, again, as much acceptability as possible.

Vic Timmer at the University of Toronto and various others have been looking at folia; that is,

looking at leaf chemistry as a reflection. There's always a gap between what's available in the soil for the plants and what the plants actually take up, and the only true way of seeing what's available to the plants is to find what they have actually taken up.

One of the ways of doing that is to look at folia leaf analysis and there are some systems that have been worked out quite nicely now I think and gaining a lot of acceptability and that's also true, incidentally, both for the softwoods and for the hardwoods.

So we're quite a long way down the line from being able to do that. So there's three components there. One is using some kind of ecosystem classification once it's tested against nutrition; another one is for doing soil chemistry; a third one is for doing folia analysis; and a fourth one I think is to get into the plant community work a little bit more.

This may seem odd having said that 38 units for northwestern Ontario may be getting complicated, but certain of the species that most of us perhaps ignore, most of us do, are really very good indicators and some of the feather mosses that you get on the carpet of these northern forests are very good indicator of site nutrition. Again, there has been

work by various people.

I haven't got into that in my witness statement, but Carlton in Toronto and Maycock, these are people who have looked at these, what are frequently called lower plants or lesser plants or whatever and have come up with good relationships with nutrition.

Now, one of the snags for doing the soil chemistry part, again if we go back to agriculture, what does every farmer have available to them. Well, he has the testing labs at Guelph. He has the Ministry of Agriculture's testing labs and he can send in his samples and they'll come back and say what crappy ones to grow, they will come back and say: Here is your soil analysis, here's what you need to apply, here's your fertilizer requirement, your lab requirments and so on, and they are really quite sophisticated. It's the same for raising, you know, beef, cattle or sheep or whatever. You can get this sort of analysis.

Now, we have this vast tract of land in Ontario and we don't have such a system for finding out the nutritional status of the forest. I mean, this may sound slightly off the wall, but I do believe we should have a testing facility in this province for site specific assessments of the forest nutrition using both

folia and soil analysis.

MS. SWENARCHUK: Q. And how would such a testing facility be of assistance to local forest managers?

A. Well, it would tell them, first of all -- it would tell MNR whether these sites were truly nutritionally poor and should not be harvested, if that was the position at the time.

It would also tell them -- it would have to be related to silvicultural post-cutting operations, and again in Sweden this has been looked at and this needs to be developed. You know, I am saying this is a slightly off-the-wall suggestion, but, you know, I think we're walking into a serious problem personally and here is one way, at least in agriculture, it has been recognized and it has been dealt with. Now, I know in agriculture they are putting things on every year, but we actually have more time with the forests.

MADAM CHAIR: Excuse me, Dr. Hutchinson, did you say that it would be -- samples would be taken post-harvest or pre-harvest?

THE WITNESS: No, I said pre-harvest. I do believe we should mesh the harvesting systems to the silvicultural. We should have both at once, rather than trying to see how we can deal with the site after

it has been cut. I think it's very important knowing in advance how it will be dealt with afterwards in the most optimal way for sustainability.

MS. SWENARCHUK: Q. We may have just done it, but I wanted to ask you to clarify what you referred to a moment ago as relating to post-harvest silviculture?

A. Relating to it?

Q. Yes.

A. Run the question past me again.

Q. Yes. How would such a testing facility, as you have described, be used by foresters in relation to post-harvest silviculture which is what I think you referred to?

A. Well, I was really saying this -- I mean, I taught about this obviously, but I was saying this in response to Mr. Martel's question as to how you might recognize these sites.

Obviously if you have some method of actually chemically assessing the soils and foliage, you are a long way to doing that. Right now, we are rather struggling to do that. I mean, you have got to have some acceptable methodologies and techniques, the equipment and expertise to run it so that we can be comforted in the results.

The way to do that for agriculture is to have it all done in one place with a great deal of testing. Now, we do it a little bit in forestry. Right now they are sending out samples of foliage to be analysed from Sault Ste. Marie. I just got my batch to analyse. So they attempt in a small way to get people in different labs to calibrate things together, so we can be confident that our results represent something close to the truth or how far we are away from it, but that's really kind of, you know, seat of the pants organization.

This is something that I would suggest should be really developed in detail so that -- you know, we have various testing things done of course with forests now, but this would need to be a very organized facility with high quality.

MR. MARTEL: Do we have the knowledge of doing it but not the--

THE WITNESS: Yes, I believe we do.

MR. MARTEL: --equipment.

THE WITNESS: I think we do.

MS. SWENARCHUK: Q. You think we have the knowledge or the equipment, just to clarify?

A. Well, the equipment I'm sure we have. Now, whether -- if you put 20 soil chemists together in

a room, you would get a terrific argument as to whether we could do it for each of these elements. And even if they could agree how to do it, the big question is: What does it mean. So we'd have a big debate as to what it means.

If we are trying to sort out into rather broad categories what it means, if we are trying to sort out, let's suppose, into sites which are nutritionally inadequate, we could certainly do that. If we try to get into incredible subtleties right across the spectrum, we would probably just end up in huge debates.

At Laval, they are into this analysis of foliage in quite a large way for Quebec and I think they are rather successful in it. As I say, Timmins got little things going here and we have things across the province that can handle part of it, but this is not the way it has been addressed.

MR. MARTEL: Do they apply, though, what they know in Quebec to, for example, limiting the type of cutting that goes on or do you have the knowledge --

THE WITNESS: No, they don't have it for reason. They have it right now to look at sugar maple decline because that's very important to Quebec. That's what they're setting it up for and they're

making recommendations on fertilizer, they are making recommendations specifically about what fertilizer and at what levels to use it in Quebec based on this.

So I wasn't saying it has got a 10-year history, that has been set up in the last two years, but I think it is in the right direction personally.

MR. MARTEL: That takes me back to my original question because --

THE WITNESS: I thought I answered that.

MR. MARTEL: You attempted to answer it, but somewhere in this circle I got -- do we have the capacity or the (a) the knowledge to do it; (b), the equipment to do; and, (c), if we have it, why aren't we doing it.

MS. SWENARCHUK: Let's take those one at a time.

THE WITNESS: I couldn't answer the last question.

MS. SWENARCHUK: Q. Dr. Hutchinson, do you agree that we have the knowledge to do this type of analysis at this point?

A. Oh, yes.

Q. And do you agree that we have available in Ontario is equipment to carry it out?

A. Well, it would need to be organized.

Q. So is that the element that's missing?

A. I mean, it exists. Most of the labs have equipment which can carry out components of this. So we certainly have that capability.

I mean, we need to have some big debate as to interpretation of this data. That would be the biggest debate to take place. There will be lesser debate as to how to exactly measure these things for soils and there would be an even lesser debate I think for vegetation. So this is the kind of spectrum of noise in the system.

Q. Would there be a debate about which of these results led to the conclusion that a particular site was of low fertility?

A. I don't know.

Q. When you said there would be considerable debate, on what subjects would there be debate?

A. How you interpret the analysis, the chemical analysis, especially the soil solution chemistry analysis. That would generate quite a lot of debate, it always does.

It seems to me that MNR, with its ecosystem classification system, if it grafted on to

that some of the sorts of things I'm talking about, we would have a system that could be used, but of course it would need to have the lab organization set up to do the testing. So it would need to prove those two axes as to what they need nutritionally right now, you know, the axis of vegetation type versus soil classification.

Once we have got that done - I mean, that might sound easy - but once we've got it done, we'd be in a very powerful position to be looking site specifically and to press ahead with these warning lights on about nutritional depletion and non-sustainability of practices I think. It means that we should be -- we are looking at this alternative.

MS. SWENARCHUK: That was a subject I had planned to come to later, Mr. Martel. Are you satisfied that your question has been answered now?

MR. MARTEL: To some degree, yes.

MADAM CHAIR: I think part of Mr. Martel's question had to do with the size of the task; in other words, is the forest -- is the size of the task in analysing forestry samples larger than that of all agriculture in Ontario that would use the University of Guelph agricultural lab, or are you talking about tens and tens of thousands of samples that of course it would not be possible to do a regular

sort of analysis on every site or every hectare that you cut?

THE WITNESS: I don't think it would be bigger than -- I don't think it would be bigger at all than the agricultural operation at Guelph that does this because individual farmers all across the province can send that in.

We have to decide what we might mean by site specific and things like that, but I don't think it's, by any means, insurmountable to do this. I mean, it just occurs to me, I mentioned Guelph could take this up, but of course they are use to telling you how much nitrogen you need to put on your corn crop and things like that. I don't think the foresters would too enthused to get that sort of information for growing black spruce, so it would need to be geared to forestry.

MR. MARTEL: You might want to do it northern Ontario.

THE WITNESS: MNR could probably do it themselves.

MR. MARTEL: I say, you might want to do it in northern Ontario as opposed to Guelph.

THE WITNESS: That would be terrific.

MS. SWENARCHUK: Within the Ministry of

Northern Development perhaps.

Q. I think I would like to move on then, Dr. Hutchinson. At page 20 of your witness statement, No. 1, you referred to soil acidification relating to full-tree harvest?

A. Yes.

Q. In the first paragraph on page 20, midway through you said:

"When slash is removed from the site, this favourable situation..." that is, favourable for root growth and mycorrhizal function, "...is destroyed. Soil acidification occurs, unfavourable for a healthy decomposer microbial population, unfavourable for root growt, unfavourable for mycorrhizal establishment, and in a direction leading to potential aluminum toxicity. The slash removal also takes away a high percentage of essential nutrients, as repeatedly shown in studies referred to above."

Now, could you explain for us now, Dr. Hutchinson, the process by which full-tree logging leads to the soil acidification that you have described?

A. Well, if we accept for the moment the contention that removing the foliage takes away a substantial portion of the calcium, potassium, magnesium from the site and other things too, then that means they no longer are available to be returned into the soil. Now, those base elements are the ones which would be normally available for neutralization--

Q. A little slower, I think.

A. --neutralization of the site generated acidity. You've also -- so what you've done is you've taken away neutralizing the two, you've also taken away some plant essential elements in rather large quantities. So if you leave slash on site, as it decomposes, this material will be returned to the site and you may have some slight increases in pH as you get after fire which is rather a faster way of doing the same sort of thing.

So if we go to full-tree harvesting, then we are taking away all this neutralizing material and there are various reports which indicate that in general you see site acidification taking place as a consequence of this. Site acidification creates these conditions which are somewhat undesirable. It depends on how much of it occurs. Again, it does depend on your site and your soil chemistry to start with and so

on.

If we do take -- if we create soil acidification, we can run into microbial problems, you will create -- it's like getting an acid stomach. It is not great for the normal -- flora is foreign in the stomach, so we have created an unfavourable condition, and what is particularly dangerous in doing that is to run into problems of knocking off your nitrogen, your microbes that are concerned with the nitrogen cycle.

If you have already got fairly acidic soil, and we have in many of the circumstances in the north, let's suppose the pH is around about 4.5, which is really quite common, and we acidify a little bit, then the normal aluminum that's minding its own business in inert form in the clays and bound with some of the organic matter, that can go into solution and basically that is bad news for plant root systems and for a lot of microbial processes and it's bad news particularly for mycorrhizal.

Q. In what way?

A. It inhibits growth, it's a toxic element in quite low concentrations.

Q. Now, you've indicated a level of acidity that you said is quite common in forest soils. In general, if you could, would you characterize boreal

forest soils as acidic or susceptible to acidification?

A. Well, if I characterize them as acidic, people can take me all over the province and point to alkaline ones. So, I believe we are talking about generalizations.

The basic process for our soil areas, there is postilization (phoen) which is a leaching of nutrients from the soil. That takes us in the direction, normally speaking, of acidification. We have the decomposition products from your needles which are acidic, you know, the tannins and resins and so on, they give you the humic gases and the tonic acids and so we have an acid leach going through the soil.

The coniferous litter falling is rather base poor, so there is a general tendency to be moving in the direction of acidification anyhow. We get relief from this when fire comes through, that sort of takes the break off and releases all the basis in a short period of time.

You were asking --

Q. My question relates to the degree to --

A. I will say predominantly our boreal forests are growing on acidic soils. I could define what I mean by acidity if you want, but there are lots

of exceptions.

Q. Very well. Define what you mean by acidity?

A. I will define it in very simplistic terms in of pH. Let's say pH 5.2 or less. We probably won't get too much argument with that.

Q. Now, what exactly are you saying? What does the 5.2 relate to? That is the level acidity?

A. Sorry, the pH of the soil, solution.

Q. Right.

A. If we look at the soils which have developed on granitic rocks, you will be pretty comfortable in saying they would have a pH of 5.2 or less. The surveys we have done in the north, there's some surprise in the acidic soils, I think we've got pH's down to 3.4 which, compared to 5.2, is nearly a hundred times -- yes, nearly a hundred times more acidic.

Q. Now, your reference on page 20 of panel 1 to the soil acidification problems relates to full-tree harvesting. I wanted to ask you whether in your view there is a problem of increased acidification of soils related to conventional bole-only harvesting as well?

A. It is substantially less. I mean, one of the things with bole-only harvesting is you are taking biomass. You are taking wood off the site, so to an extent you are taking bases off the site too, but if you are leaving the slash and that happens to be nutrient enriched relative to the bole and it contains quite a high percentage of it and it's also relatively decomposable, it will break down substantially more rapidly than falling logs will.

Well, you know, just from my own point of view, I don't have any great difficulty with that. I don't think that's -- I mean, we can look at the literature and I think you will find that people are not pointing to bole-only harvesting and saying: This is the primary cause of soil acidification.

Q. So you don't have concerns with bole-only--

A. No.

Q. --on those sites. Fine.

Continuing for a moment on the issue of nutrient losses after whole-tree harvesting, are there additional nutrient losses after the removal of the trees from the site.

MR. FREIDIN: You said whole-tree?

MS. SWENARCHUK: I meant full-tree,

excuse me.

THE WITNESS: Yes, because, you know, in the normal process it will stir up the site. These are not necessarily additional to conventional harvesting. The big difference is what you take off the site, but when -- okay, so we have taken full trees off the site as opposed to just bole only.

We have an additional process, in both cases it goes on; that is, especially release of nitrogen from the organic matter which is decomposing now and which may be released before you've got the trees on that site that you want to try and grow again, and that's due to microbial decomposition and nitrification denitrification and release of nitrogen oxides and ammonia under the right circumstances in the atmosphere, and there is also leaching of course into your waterbodies. There is substantial leaching following clearcutting.

Now, I don't know if you want to me introduce this other paper that we keep referring to and nobody has seen. This is a 1990 paper and it's -- I mean, I can read some of this into the record, if it's appropriate.

MS. SWENARCHUK: Q. Yes. I was wondering-whether to start now or wait with that until

tomorrow, but I believe we could start now.

A. We can start now, okay.

MS. SWENARCHUK: If you will just give us a moment we will distribute the paper.

THE WITNESS: This is a --

MS. SWENARCHUK: If you will just wait a moment, I will distribute it first.

MADAM CHAIR: Do you want an exhibit number for this, Ms. Swenarchuk?

MS. SWENARCHUK: Yes.

MADAM CHAIR: This paper will be Exhibit 1409 and its title is Distribution of Biomass and Nutrients in Some New Brunswick Forest Stands, Possible Implications of Whole-Tree Harvesting, authors S.M. Maliondo, M.K. Mahendrappa and G.D. van Raalte and it's published by Forestry Canada.

Is there a date on it? Oh, 1990. It is 40 pages.

---EXHIBIT NO. 1409: Forty-page paper entitled Distribution of Biomass and Nutrients in Some New Brunswick Forest Stands, Possible Implications of Whole-Tree Harvesting, authors S.M. Maliondo, M.K. Mahendrappa and G.D. van Raalte, published by Forestry Canada, 1990.

MS. SWENARCHUK: If I could just, for the convenience of the Board, indicate that the first line

of the first page identifies that in this paper they are using the term whole-tree harvesting as the removal of all above-stump tree components.

So in this paper, as has happened in other papers we have seen, the term whole-tree harvesting is being used in the same way that we have used here full-tree harvest. As I say, that's the first line of the first page of the paper.

MR. CASSIDY: I'm sorry, just so I can be clear. Is it your position, Ms. Swenarchuk, that this paper was available after the witness statement was produced?

The only reason I ask is I can't seem to find the date other than 1990 on it.

MS. SWENARCHUK: It arrived in our office in the last two weeks.

THE WITNESS: I saw it the first time about ten days ago. I don't know whether it was actually released or not, but I've had it ten days now.

It is not maybe as dramatic as we are making it sound because it really reiterates the things that Maliondo and Mahendrappa have previously published, so it is update on it. It is maybe a more detailed review of the situation, including some of that data on 24 sites in New Brunswick.

MR. CASSIDY: I didn't mean to lead your examination-in-chief for you, I simply asked the date of this thing.

MS. SWENARCHUK: Q. Now, Dr. Hutchinson, the discussion in this paper begins on page 26; does it not?

A. Right.

Q. Now, can we begin with the obvious fact that this paper was written with regard to New Brunswick forests and to what extent, in your view, the opinions of the writer of this paper apply as well to Ontario forests and, if so, for what reason?

A. Well, okay, so you are really asking if this has applications in Ontario?

Q. Exactly.

A. Well, the examples they quote are from places other than New Brunswick and some of them are from Ontario, and they are dealing with some of the sites, they are dealing with coniferous sites and some of the boreal sites.

So I think to a substantial extent it can be applied to Ontario. I mean, you know, you might want to qualify it sort of on a site-by-site basis, but the general conclusions they come to, based on this wealth of literature, it would be odd if they were not

applicable to Ontario. They're clearly applicable. They have given the example of Quebec.

Q. Let me ask the question this way: From your knowledge as a scientist and forest ecologist, is it reasonable that observations like theirs related to the boreal forest of New Brunswick be assumed to have some application to the boreal forest of Ontario?

A. Yes. The coniferous forest, yes.

MS. SWENARCHUK: Madam Chair, I would prefer not to get into the document. I think it's going to take us more than 10 minutes to get through it and I would refer to wait until the morning, if that's acceptable.

MADAM CHAIR: All right. That's fine, Ms. Swenarchuk.

MS. SWENARCHUK: Pardon me?

If we could convence tomorrow morning then.

MADAM CHAIR: Nine o'clock. That's fine.

We will try to get in touch with Mr. Hanna. I think at one point Mr. Hanna told the Board that he was occupied at another hearing, but I didn't think that applied to your first witness panel, I thought that was later on.

Anyway, we will see you all tomorrow.

Thank you very much.

---Whereupon the hearing was adjourned at 4:50 p.m., to be reconvened Tuesday, October 2, 1990 commencing at 9:00 a.m.